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The Effects of Pollutant and Weather Variations on Asthma Rates in Brooklyn, New York

Summary

This research was done to analyze the effect of air pollution on asthma. One major goal of this project was to find out which of the pollutants that were analyzed had the greatest effect on asthma occurrence. This is significant because my research can be used to create environmental laws, which will regulate the production of this pollutant in order to reduce and control asthma. It was found that nitrates, which are found largely in diesel fuels used by cars and other vehicles, have the greatest impact on asthma sufferers.

Abstract

The focus of this project was to characterize the daily effects of pollutant variations and weather variables on asthma rates in Brooklyn, New York. Five data sets were used: one for the weather variables, two for the pollutants and two for the asthma. The weather data came from www.wunderground.com. The pollutant data came from the Environmental Protection Agency in New York and the New York State Department of Environmental Conservation (NYSDEC). The asthma data was acquired from Mount Sinai School of Medicine and the Center for Disease Control (CDC). The pollutants analyzed were carbon monoxide and particulate matter. The weather variables were daily temperature change (max. – min) and visibility, which was used as a proxy for cloud cover. These were compared to asthma statistics to define which pollutant has the greatest effect on the rates of asthma in Brooklyn, New York.

Introduction

Exposure to pollutants, including carbon monoxide and particulate matter, has been found to have an effect on the respiratory health of humans (Clark 1999). The effects of these pollutants on asthma incidences in the area of Brooklyn, New York were investigated. Weather variables were also compared to variations of the asthma and the pollutants. The focus of the research was to find out which pollutant has the greatest effect on asthma and

which weather variables have a correlation to the asthma data. This research was done to see which pollutant has the greatest effect on asthma in order to possibly create new environmental laws, in areas with high asthma rates that might control the production of those pollutants.   There is not much known about the causes of asthma or the components that increase the number of asthma cases, so this project will add to the information that is being collected on this subject.

Particulate matter (PM) plays a big role in the status of asthma sufferers. Major sources of PM are road dust and combustion-engine exhaust. This pollutant has also been found to have an effect on asthma patients. Particulate matter has been associated with reduced pulmonary function, increased chronic respiratory symptoms and increased mortality from respiratory disease (Schwartz 1996). In one study conducted in Anchorage, Alaska, it was found that the trend of PM 10 (particulate matter with a size of ten microns or less) was directly correlated to the trend in asthma visits. The rate of medical visits related to PM10 was higher on warmer days. This study also stated "particulates with a diameter of less than 10 micrometers in the ambient air have an adverse effect on asthma patients that is independent of other pollutants. " (Choudhury 1997).

Daily variations in hospital admissions for asthma were compared to the daily variations in these pollutants for the year 1997. Annual asthma mortality rates were compared to levels of sulfates in particulates, nitrates in particulates, which can be used as a proxy for diesel fuels and carbon

monoxide, which can be used as a proxy for combustion processes, from 1988-1996. The variations were also compared to climate variables, including temperature change (max. – min.) and visibility, which was used as a proxy for cloud cover.

Methods

This research was conducted using five different datasets: one for the weather variables, two for the asthma rates, and two for the pollutants' rates. They all covered the same area, Brooklyn, New York. For both the asthma and the pollutants, one set was a record of daily readings from 1997, while the other was a record of annual averages from 1988-1996.

The dataset for the weather variables was taken from an Internet site called "Weather Underground" ([www.wunderground.com)](www.wunderground.com).   This site has weather information available for the entire United States. However, the set that was used was only the daily records for Brooklyn, New York in 1997.   This particular dataset was used for the temperature change (max. – min.) and visibility. All temperature readings were recorded in degrees Celsius and visibility was recorded in miles.

The daily record of carbon monoxide was received from the Environmental Protection Agency (EPA) of New York. This data, along with the asthma data, was not available on the Internet. The raw data from the Ambient Air Quality Report of 1997 for Brooklyn, New York was the set that was used because it was the only set available that had daily records for 1997. This data was obtained from the Regional Contact for the EPA. A daily record of

particulate matter readings was not available because the EPA takes those measurements every sixth day. The yearly averages for the carbon monoxide and particulate matter were obtained from the New York State Department of Environmental Conservation (NYSDEC) annual reports section. This data was available on the Internet at the NYSDEC website (www.dec.state.ny.us). The carbon monoxide, in both datasets, was measured in parts per million (ppm). The particulate matter was recorded in an annual average from 1988-1996 in micrograms per cubic meter (ug/m3).

The dataset for asthma was extremely difficult to get. The data was requested from many hospitals in the New York City area and all of them were very reluctant to release the data. The daily hospital admissions records for asthma were finally obtained from Mount Sinai School of Medicine. This was a record of the daily records for one zip code in Brooklyn, 11215. This zip code was used because it was the only one included in the available dataset in which an EPA collecting site was found. This was an ideal set because the hospital admissions records give a general view of those who come into the hospital to be treated for asthma-related problems. However, it would have been better to have analyzed more than one zip code in order to characterize the level of asthma in the borough of Brooklyn. The annual asthma mortality rates were taken from the website for the Center for Disease Control (CDC) because they included data from the whole of Brooklyn and allowed a more complete analysis. Mortality rates are not as accurate as hospital admissions because they only account for those who have died from asthma, but they were

used because they cover a longer time span. The asthma mortality rates were compared to the sulfate and nitrate fractions in total suspended particulates and in inhalable particulates (PM10).

Results

It is known that several researchers have studied the daily variations of asthma rates in New York City separated by zip code (Noble 1999). Dr. Philip Landrigan (Claudio 1999) feels that the real important and unanswered question relating to this area is "Why have asthma hospital rates doubled in the past decade?" His theory is that there may have been a subtle deterioration of in a specific aspect of air quality during this time period.

When the asthma data was compared to the pollutant data, it was evident that there was a relationship between the nitrate fraction of inhalable particulates and the asthma mortality rate. While the sulfate fraction in both inhalable and total suspended particulates and the nitrate fraction in total suspended particulates went down from 1988-1996, the asthma mortality rate and the nitrate

fraction of inhalable particulates have increased during the same time period. Also, while there was a downward trend in the daily records of both carbon monoxide and asthma admissions in 1997, the carbon monoxide decreases from 1988-1996, while the asthma mortality rate increases. There was no real relationship noticed between the daily asthma records and those of the weather variables.

Discussion

      This project was conducted in order to analyze the correlations between asthma incidence, carbon monoxide and particulate matter. It is evident that there is a link between the asthma rates and the variations of the pollutants. This link, once quantified, could shed some light on how to reduce the number of asthma cases in the city. The relationship between the nitrate fraction of inhalable particulates and asthma mortality rate can be explained by an increase in the number of cars being driven from 1988-1996. Since the nitrate fraction the particulates can be used as a proxy for diesel fuels and there is a relationship between the nitrates and the asthma, the belief that diesel fuels have an impact on asthma incidence is confirmed. While the nitrate fraction of total suspended particulates has decreased over these years, the nitrate fraction of the inhalable portion of these had increased.   This is significant because the inhalable particulates are the ones that have an effect on the lives of asthma sufferers.   The decrease in the sulfate fraction of both total suspended and inhalable particulates could be due to a decrease in the usage of fossil fuels and coal burning (fig.1).   The difference in the relationship between carbon monoxide and asthma in fig. 2 and fig. 3 is partially due to the difference in the time span. While fig. 2 only shows the relationship for one year, fig. 3 shows how the two factors are related over a longer period of time. Also, the downward trend in the asthma admissions in 1997 could be due to the fact that this data only includes one zip code in Brooklyn, while the asthma mortality rate data is for the entire borough. The fact that the asthma mortality

rate increased while the carbon monoxide levels decreased indicates little or no relationship between asthma incidence and other combustion processes. Due to the results obtained from this research, it can be concluded that the cause of asthma is a combination of a gas that the EPA doesn't monitor and inhalable particulates, mainly nitrates. This can be stated because none of the gases that were observed had a correlation with the asthma data and, while there was a correlation between the nitrate fraction of inhalable particulates and the asthma, it was obvious that this was not the sole cause.

References

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